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ABSTRACT

This study investigates whether Mexican Americans have a different cerebral specialization for native language than for second language as measured by visual shift. The possibility of a different cerebral arrangement for each language has implications for educators. The relation between cerebral arrangement and cognitive style entails considerations concerning methods of instruction, grouping, reward systems, and assessment. The research sample consisted of thirty-two bilingual English-Spanish right-handed males and females between the ages of twelve and sixteen. Visual shift, looking away from the examiner upon being asked a question, represents a switch from external to internal processing. It has been found to be a function of eye movement contralateral to cerebral activity. The results indicate that students sampled in this study tended to shift to the right when answering questions in English and to the left when answering questions asked in Spanish. For this sample, the left hemisphere was the preferred mode of thought in English while the right hemisphere was the preferred mode for processing questions in Spanish. These results indicate that processing modes are biological as well as cultural and individual. In addition, there is a change in cerebral arrangement due to second language acquisition. (JK)

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CEREBRAL LANGUAGE ARRANGEMENT FOR MEXICAN AMERICANS

by

Kathryn Brue de Lorenzo

A THESIS Submitted in Partial
Fulfillment of the Requirements for
the Master of Education in Professional Development

Adviser: Dr. Paul Yvarra

UNIVERSITY OF WISCONSIN-WHITEWATER

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CHAPTER I

DESCRIPTION OF STUDY

Introduction

Statistical information indicates that the American educational system is failing to meet the academic needs of the Mexican-American student. As a group, Mexican-American students consistently score lower in the parameters which usually define school achievement: grades, achievement scores, and I.Q. tests. The median level of education for the Mexican American is 8.1 years as compared with 9.8 for the Native American, and 12.4 for the Asian American (U.S. Commission on Civil Rights, 1975). In the southwest, the average number of school years completed by the Mexican American is only 7.1 years (Kobrick,1976).

Mexican Americans consistently fall below the national average in all areas of achievement. By the 12th grade, he is 4.1 years behind the national norm in math achievement, 3.5 years behind in verbal scores, and 3.3 years behind in reading. These figures do not take into account the 45% drop-out rate (Eldridge, 1978): students who never graduate from high school and who begin dropping out during their junior high years. The drop-out rate for Mexican Americans has been double that of Caucasian students throughout the 70's.

Among the Mexican-American students who continue their education, many do not function at grade level and experience continual set-backs and frustrations. Of those who reach the 12th grade, 35% are a full two years behind grade level. 17.2% of the Mexican-American population in the United States has less than five years of education, as reported by the National Center for Educational Statistics.

Language has been identified as one factor in their academic failure. Approximately 19 million individuals, 11% of the American population, possessed a non-English mother tongue in 1960 (Fishman, 1976). Obviously, these numbers are increasing today with the new waves of Asian and Spanish-speaking immigrants.

American school teachers have often considered it their professional responsibility to bring minority children into the mainstream of American culture. The school has been a place to learn a specified cognitive style.

> Historically, then, the public school has been monoculture in conception, or culturally exclusive. Traditionally it has made no systematic provision for language,

> heritage, values, and learning styles characteristic of other cultural, racial, or scoial groups. (Castañeda, Herold, & Ramirez, 1977, p.10)

Speaking to the needs of the language-and culturally different, Bilingual-Bicultural Education was introduced in 1968 through the Title VII Amendment to the 1965 Elementary-Secondary Educational Act (ESEA). Through the implementation of these programs, the student who speaks a second language is afforded the opportunity to receive instruction in that language while learning English. However, the educational statistics continue to indicate problems.

There are many factors outside the school contributing to these problems, including motivation, socio-ecomonic backgrounds, cultural values, language, self concept, and role perception. However, the possibility that the American educational system has failed to provide a meaningful education cannot be eliminated. Mexican-American students express a less positive view toward education than do other ethnic groups (Ramirez, Taylor, & Peterson, 1971). The system itself and the failure of educators to adapt has been a partial cause of this negative perception.

The American school system has been described as having a Field Independent approach: emphasizing competition over cooperation, parts as discrete from the whole, and a task centered and analytical emphasis in learning (Castañeda & Ramirez, 1974; Konstadt & Forman, 1965).

Research indicates that certain cultural groups have specific learning styles. Blacks, Native Americans, and Mexican-Americans have been found to be primarily Field Sensitive in learning style by Castañeda and Ramirez (1974). A Field-Sensitive learning style refers to a cognitive approach that is more cooperative than competitive, teacher oriented in learning, imaginative, global and holistic in perception, and sensitive to social environment (Messick & Damrin, 1964; Moore & Cuellar, 1970; Witkin; 1965).

The learning style of American Indian children was found diametrically opposed to the style that the Anglo school represents (Engle, 1975). Cohen (1969) considered economic factors in her study and found that the Field-Sensitive relational style was prevalent among low-income groups. Support is given to the idea that there is a difference in concept formation and reasoning in the lower socio-economic child (Raph, 1967). Stodolsky and Lesser (1967)

studied cognitive learning style as related to ethnicity and concluded: "Different kinds of intellectual skills are fostered or hindered in a different cultural environment" (p. 562).

In a study carried out by Kershner (1972), Anglo children were found superior in a verbal task matching orally presented words with objects, but Chicano children were found better in tasks of visual-spatial ability. Kershner's conclusions were: "It is not clear why there should be such a distinct difference in information processing strategies" (p. 71).

Speculations as to the differences in learning and processing strategies among the Mexican-American students, as well as their overall failure in the American educational system, led to the problem of the study undertaken in this paper. Considering that culture affects cognitive style and that there exists a relationship between cerebral hemispheres and cognitive style, there also exists the possibility of distinct cerebral patterns for each language.

Language has been termed "the umbilical cord to culture". Language is the very vehicle that transmits culture. Consider the bilingual student. He possesses the distinct ability to think and process information in two languages. This paper investigates

two realms and attempts to bridge the gap between them: the realm of language and that of cerebral functioning in man.

Statement of the Problem

Do Mexican Americans have a different cerebral specialization for native language than for second language as measured by visual shift?

Significance

The possibility of a different cerebral arrangement for each language has implications for all educators. The relation between cerebral arrangement and cognitive style entails considerations for all educators concerning methods of instruction, grouping, reward system, and assessment.

It has been found that a child's cognitive style is formed during the first six years of his life (Lugo & Hershey, 1974). Concurrently, brain lateralization for specific functions is taking place before the age of six and even during infancy (Entus, 1977; Molfese, 1977). Cognitive style refers, in general, to the way a person perceives parts or wholes, to the manner in which he processes information. If cognitive style differs among groups of children, then development would depend not only upon I.Q., but also on the consistency of style within which this development is

initiated, and continued thoughout their education. A child approaches the school system with a learning style and a biologically based processing system. If these learning styles are different for children of bilingual heritage than for monolingual children, the educational system in general would need to make the appropriate adaptations.

A second area of significance would be for Bilingual-Bicultural Programs. In the past, the main concern of such programs has often been the learning of English as a second language. The goal has been to bring the culturally-different child into the mainstream of American education and the American way of life as quickly as possible. The question of cerebral arrangement for the first and second languages should have significance for such programs.

If there are different cerebral arrangements for each language, bilingual programs would need to go beyond linguistic considerations if they are to reach the academic needs of bilingual students. Alternate methods of instruction should be considered, depending on the language of instruction. Certain disciplines might be better taught in the native language, others in the second language. Bilingual programs will probably not fulfill their potential without recog-

nizing a child's learning style in both languages and proceeding from that point.

Thirdly, there are implications for the teacher of a second language: foreign language instructors. The most fundamental dichotomy of second-language learning is the inductive versus the deductive approach. In the deductive method, exemplified by the Transformational-Grammar Method and the Direct Method, the underlying assumption is that practice internalizes the rule. The deductive method, influenced by Skinner, has been predominant in second language instruction since the 1940's. It has only been seriously questioned in the last five years. The Audio-Lingual and Silent Way Methods utilize the inductive approach to second-language acquisition, where it is the ability to make generalizations that internalizes the rule.

There are indications that the inductive versus deductive approaches are cerebrally based. In a study carried out by Hartnett (Krashen, 1975), one group of students was taught a second language by the inductive approach, the other group by the deductive method. Hartnett then theorized that there is a relation between the preferred method of second-language instruction and cerebral specialization. He conducted

a visual shift study wherein he asked all members of each group, "How many letters are there in the word 'Mississippi'"? A right visual shift indicated left-hemispheric activity and a left visual shift was significant of right-hemispheric thought.

Hartnett found that the "right movers", indicating left-hemispheric thought, consistently preferred the deductive approach. Among the "left movers", which indicated right-hemispheric involvement, there were equal numbers of students preferring the inductive and deductive methods.

Foreign language instructors have, in the past, tended to follow the prevalent theory of the moment, not giving considerations to learning differences as related to language or individuals. The consideration of cerebral preferences and learning styles for language provides a fruitful area of research for teachers of a second language.

A fourth area of significance concerns psycholinguists and neurologists in their research on brain functioning. The vast majority of studies of brain organization have been carried out on monolinguals. If there is a different cerebral specialization for bilinguals and polyglots, if indeed individuals who speak two or more languages are more

bilateral in their brain structure, this should be considered in future research.

Groups of bilinguals and polyglots provide additional information as to the characteristics of the brain. More specifically, such research is essential in providing information concerning the functioning of the right hemisphere. If the learning of a second language can affect cerebral organization, then the brain should be viewed as a dynamically changing organ which can be modified through the process of learning.

Hypothesis to be Tested

There is no significant difference in cerebral arrangement as measured by visual shift for a group of Mexican Americans when answering questions in Spanish and when answering questions in English.

Definition of Terms

Mexican American: An individual born in the United States of Mexican heritage. For the purpose of this study, Mexican American will also include an individual born in Mexico who moved to the United States during the first ten years of his life.

Bilingual: The ability to alternate between two languages (Weinreich, 1953).

Visual shift: A shift in eye motion to the left or to the right upon being asked a question.

Cerebral arrangement: Man's brain can be divided into three parts: The lower or stem, the midbrain, and the cerebral cortex. The cerebral cortex is divided into two symmetrical hemispheres, one on the right side and one on the left side. Most of the functions of the left side of the body are dominated by the right hemisphere; most of the control of the right side of the body is dominated by the left hemisphere. Cerebral arrangement refers to left or right hemispheric involvement in thought processing strategies.

Limitations

1. The small size of the sample group and the restriction of selection of subjects to a single geographical area may preclude generalizations to the Mexican-American student population.

2. Since true random sampling was not possible, the conclusions of the study will only apply to the participants. The study cannot be seen as conclusive for the general Mexican-American population.

3. Different degrees of "bilingualism", that is, degree of proficiency in the ability to alternate between two languages, may affect thought processes and consequently the results of the study.

4. The effect of only two trials in each language may produce a practice effect. In future studies, more questions might be asked in each language.

5. For statistical purposes, the repeated measures for each individual were treated as if they were independent measures of different individuals. This may reduce the abilty to generalize from the results.

6. A further threat to external validity is caused by reactive arrangement. The novelty of such a study may affect the subjects' performance, and consequently, the validity of the results.

CHAPTER II

REVIEW OF RELATED LITERATURE

Cerebral Specialization

The establishment of cerebral hemispheres and cerebral specialization has been well researched from a variety of perspectives. Language was the first higher cognitive function discovered as asymmetrical, representing one of man's cerebral hemispheres. It remains today the best documented case of hemispheric specialization. In 1836 Dax postulated the doctrine of cerebral dominance: Language is controlled by the cerebral hemisphere opposite the preferred hand.

Although research has found no clear cut measure between dominance and handedness (Kinsborne, 1978), clinical evidence has shown that damage to the left hemisphere interferes with and can destroy language ability (Gunderson, 1970; Krashen, 1976; Ornstein, 1972). Left hemisphere lesions often cause aphasia, a condition wherein patients are rendered speechless.

Each hemisphere controls different brain and body functions. It has long been known through clinical studies that damage to the right hemisphere does not affect language. For this reason, the left hemisphere is often refered to as "major" or "dominant"; the right hemisphere is termed "minor" or "non-dominant".

In his research on the brain, Ornstein (1972) considers each hemisphere to be "major" in its own right. For a mathematician, damage to the left hemisphere would be major. For a musician, however, damage to the right hemisphere would be considered more severe. Because each hemisphere has different specializations, damage to either affects people in different ways. The terms used in this paper will be "left hemispheric" or "right hemispheric" when discussing the left or right specializations.

The right hemisphere has long been labled the nonverbal hemisphere because right lesions do not affect the ability to talk. Recent research has been concerned with finding out what specializations the right hemisphere does have. It has been found that the right hemisphere is primarily involved in spatial orientation and spatial relations (Bryden & Allard, 1978; Gowan, 1979; Krippner, Dreistadt, & Hubbard, 1972).

It is for the spatial function that the right hemisphere specializations have been most researched and documented. Kohn and Dennis studied adolescent individuals who had suffered infantile hemiplegia and in whom the diseased hemisphere had been removed. The researchers found that the individuals who remained

with only the left hemisphere were able to perform some spatial tasks but were impaired in later-developmental spatial tasks. Individuals who had only the right hemisphere were not impaired in any spatial tasks (Witelson, 1977).

A number of other functions have recently been connected to the right hemisphere as well. Damage to the right hemisphere caused interference with dreaming in a study conducted by Humphrey and Zangwill (Bogen, 1969). Bakan (1969) showed correlations between right dominance and increased susceptability to hypnosis.

Musical ability has also been connected to the functionings of the right hemisphere. Luria (1966) cited the case of a musician who became famous for his music only after a case of left hemisphere aphasia. Although aphasia is produced by a left hemispheric lesion, the ability to sing is retained. Yeni-Komshian(1977) cites, for example, the case of a child hit by a car at the age of 7.11. He received a fracture in the left lobe which produced aphasia.

> Following this his speech became echolalic, with frequent parroting of statements with no communicative function. He became adept

> at singing songs he had known prior to the accident...He was unable to name friends and familiar objects and places. He used gestures for communications (p. 147).

Although he could not produce original speech, he was able to produce words in songs.

In various studies, musical ability was found to be impaired if the right hemisphere was damaged. Deficiencies in such cases were found in both timbre and tonal memory (Bogen & Gordon, 1971; Kimura, 1964; Kimura & Folb, 1968).

Processing methods have been found to differ in left hemisphere and right hemisphere. The left hemishere has been found to be predominant for analytical, logical thought, especially in verbal and mathematical functions. Its mode of processing is primarily linear and sequential (Agranowitz & McKeown, 1975; Kinsbourne, 1978; Ornstein, 1973).

The right hemisphere processes information more diffusely, is more relational and holistic, and is superior in depth perception (Grigg, 1979; Harnad, 1972; Smokler, 1977). Thus, it has been shown that each hemisphere is likely to process the same information according to its own unique method of operation.

Split Brain Research

Split brain research has confirmed cerebral specialization and the existance of two separate spheres of consciousness coexisting within the human cranium. Split brain operations began in 1961 when, in an attempt to control severe epilepsy, the corpus collasum was severed. The corpus collasum is the isthmus of nerve tissue connecting the left and right hemisphere. A surprising discovery resulted. Although the operation did improve the condition of epilepsy, it also resulted in two separate hemispheres, each functioning independently. The two hemispheres were no longer able to communicate with one another.

Subsequent split brain study has provided researchers the opportunity to study each hemisphere separately. One on the most striking observations was that the operation did not produce any noticeable changes in personality or general intelligence. Close observation did, however, reveal certain changes. It was found that the split brain patients could write words with their right hand, but could no longer draw or even copy simple geometric figures with this hand. The left hand, however, controlled by the spatial, creative processing right hemisphere, could draw but

could not write or copy even the simplest words (Sperry, 1964).

Other effects were noticed. When a word was flashed in the left visual field to the right hemisphere, it could not be named or described. The patient simply could not verbalize. Verbal descriptions were only possible when the word was projected to the right visual field, controlled by the verbal left hemisphere (Gazzaniga, 1970). Likewise, when a pencil was placed in the left hand, the split brain patients could not name it or describe it in any way. Neither could verbal instructions be followed with the left hand, such as, "Stick out your index finger". Such instructions were carried out by the right hand, again demonstrating that the processing of verbal information is left hemispheric (Bogen, 1976).

These studies have confirmed that it is the corpus collasum that bridges the two consciousnesses, transferring information continually from one hemisphere to the other. All normally functioning people use both hemispheres. We verbalize, we move in space, and we do both together. Yet these split brain patients demonstrate the separate base of each hemisphere's processing modes.

Right Hemisphere's Involvement in Language

Before examining the literature in relation to cerebral specialization for different languages, it is of essence to examine more closely the right hemisphere, in particular the possibility of the right hemisphere's role in language. The function of this hemisphere and language has been controversial since Broca suggested in 1861 that speech is left hemispheric. Recent research indicates that the right hemisphere is, however, not devoid of language skills.

Nebes (1978) found that language comprehension greatly exceeds language production in the right hemisphere. The already-mentioned case cited by Yeni-Komoshian notes that the child with the left hemispheric lesion, although unable to produce original speech, was able to reproduce words and to sing songs using words. It is clear that the right hemisphere does possess the ability to reproduce as well as to comprehend language in the case of the monolingual.

Cerebral Arrangement for Bilinguals and Polyglots

Considering that the right hemisphere does have certain language-related abilities and that it specializes in processing in a spatial, holistic, Gestalt manner, it is of interest to turn to the study of cerebral language arrangement for bilinguals and polyglots, people who speak two or more languages. Hundreds of thousands of people speak more than one language, and entire countries are bilingual or multilingual. Yet neurologists' studies have been carried out predominantly on monolingual individuals.

There is no reason to believe that the first and second language for bilinguals reside in the bilingual or polyglot in the same manner as the one language of the monolingual. Albert and Obler state:

> In conclusion, then, bilinguals may differ from monolinguals by maturing earlier (both in terms of cerebral lateralization, and in acquiring linguistic abstraction skills). In adulthood, bilinguals may continue to be more verbally skillful than monolinguals. The greater verbal skills seen in bilinguals may be attributed to their cerebral organization for language, which seems to be

more bilateral than that of the monolingual". (p. 206)

In the examination of the hypothesis that there is no significant difference in cerebral language arrangement for bilinguals, there are four main areas that need to be considered: (a) aphasiological evidence, (b) postmortem studies, (c) recovery patterns of languages, and (d) studies which directly measure the variable of first and second language in relation to cerebral arrangement.

Aphasiological Evidence

Aphasiological evidence for bilingual and polyglot cases shows a condition known as crossed aphasia. Crossed aphasia refers to cases in which damage to the right hemisphere produces loss of language. Such crossed aphasia patterns occur in monolingual cases at the rate of 1-2%. Studies of aphasia cases among poyglots show a high proportion of polyglots in whom a right-sided lesion causes aphasia.

In a study conducted by Gloning and Gloning, cited by Albert and Obler, a 10% crossed aphasia rate occured in a group of bilinguals. Nair and Virmani, also cited by Albert and Obler, found that, out of 12

right-handed left hemiplegics with damage to the right hemisphere, ten had some signs of aphasia, approximately 83%. Other studies have also reported a high percentage of crossed aphasia polyglot cases as compared to monolingual cases (Charlton, 1964; Lambert & Fillenbaum, 1959). These data support the conclusion of right-hemispheric involvement for language in bilinguals and polyglots.

Postmortem Evidence

Postmortem studies on polyglot brains give evidence that the knowledge of multiple languages has anatomical consequences. Scoresby-Jackson was credited with the hypothesis in 1867 that the bilingual brain may have a distinct cerebral pattern to house the extra knowledge. In the few postmortem brain studies carried out on bilinguals and polyglots, Albert and Obler reported that crossed furrow findings in both hemispheres appear deeper than in monolingual brains. They state, "We believe it would be reckless to generalize about anatomy from a handful of cases; however, the demonstrated anatomical differences are not without interest" (p. 247).

Recovery Patterns

A third area of importance in the study of the bilingual brain is that of recovery patterns. The question is, in cases where language is lost, due to cerebral trauma, which language returns first, and why? If bilinguals and polyglots show the same cerebral functioning patterns as monolinguals, we would presume that the recovery of all languages would be simultaneous. Since we know that language is left lateralized, we would assume that left lesions would cause aphasia to all languages to the same degree.

The majority of case studies of recovery from aphasia in polyglot and bilingual cases show diversity in recovery patterns. For some individuals it is the second language that returns first. Other cases show the first language returning first. Some show both or all languages returning at the same point in time. Because of this diversity, it appears that the right hemisphere is more involved in language production in bilinguals than for monolinguals.

In a case studied by Minkowski (Goldstein, 1948), a German-born professor spoke Swiss German as his mother tongue, but was also literate in German, French, English, and Italian. At the age of 54, an apopleptic insult occured causing total aphasia. A

quick recovery of comprehension in all languages resulted. His ability to speak French returned first, then German, followed by a minimal degree of Italian. After ten years, however, he had still not reacquired the ability to speak his mother tongue.

Goldstein describes another case as reported by Hinselwood. An Englishman, aged 34, suffered total aphasia. Previously he had spoken English as his mother tongue in addition to French, Latin, and Greek. Following recovery, he read Greek well, some French and Latin, but read the poorest in English. It is interesting to note, for our purposes, that each language recovered to a dissimilar degree. If all languages were lateralized to the left, we would expect consistency in both loss of languages and in recovery patterns.

Chlenov (Paradis, 1977) reports the case of a German who suffered a trauma during the Spanish Civil War. At first he spoke only English, then, while his native German improved, his English regressed.

A case described by Albert and Obler and carried out by Bychowski describes a Pole who received a brain injury while in combat. The Polish language returned to only a minimal degree, the German of his youth never returned, but the Russian language, learned at

the age of 24, recovered first and most completely.

All of these cases indicate diversity in recovery patterns. Several theories have been proposed to explain the neurological basis for these cases. Goldstein argued that the writing system is an important factor in determining which language returns first. Paradis holds with the multiple-factors view that the order of recovery of language, degree of proficiency, affective attitudes toward each language, site and size of lesion, and the general biological condition of the patient are all factors. The Rule of Ribot claims that the language learned earliest is the last lost. The Rule of Petres proposes that the language used immediately before suffering the brain damage will be the first to recover.

No one theory embodies the continual exceptions found among case histories of bilinguals and polyglots. For the purposes of this study, it is enough to note that these cases add additional, substantiating evidence to the problem of the study: the speculation that each language may have a different cerebral arrangement for individuals who speak two or more languages.

Cerebral Specialization and Language

Although there has been little direct research on

cerebral arrangement and languages, research conducted to the present confirms that bilinguals are cerebrally more bilateral than monolinguals. Dichotic listening tests have shown a right ear superiority for verbal materials (Kimura, 1961; Neville, 1974). In a study carried out by Van Lanker and Fromkin (Kinsbourne, 1978), a dichotic listening test was given to bilingual Thai-English students. It was found that tonal words produced a right ear advantage with Thai words but not with English words. Stevens (1957) reported a case of epilepsy wherein epileptic seizures were triggered while the patient read in Hebrew but not when the patient read in English. Albert and Obler report the case of a Polish woman living in Israel, who, after a car accident, displayed spatial disorientation in Hebrew only.

Language-specific effects were also found dichotically in French versus English (Starck, Genessee, Lambert, & Seitz, 1977) and for Hopi versus English by Rogers (Albert & Obler, 1978).

A study conducted by Hamers and Lambert (1977) studied 12 French-English bilinguals. The researchers found that three of the 12 preferred a left visual field effect (LVFE), indicating a higher proportion of right dominance than would be expected in a

monolingual group. Two of the 12 showed a different dominance in English than French: English showing a right visual field effect (RVFE), French a LVFE.

Orbach (Harcum, 1978) found that when bilingual Hebrew-English students were not aware in which language or on which side a tachistoscopical presentation would be made, Hebrew words were better recognized to the left visual field when Hebrew was the first learned language. English was better recognized to the right visual field. Orbach's study indicated that, for these native Hebrew-speaking children, there appears to be a right dominance for Hebrew and a left dominance for English.

Studies in all four of these areas (aphasiological evidence, postmortem evidence, order of language return, and direct studies of cerebral arrangement and language), indicate the possibility of a bilateral language arrangement.

Visual Shift Method of Assessing Cerebral Specialization

One method used to discover which hemisphere is involved in thought process is the visual shift method. The visual cortex of each hemisphere receives input only from contralateral visual fields. Thus, contralateral eye movement indicates which hemisphere is being used in thought process. Conversely, one of

the most frequent motor responses to electrical stimulation of the cerebral cortex is eye movement. When the left hemisphere is stimulated, eyes move to the right; when the right hemisphere is stimulated, eyes move to the left. While pondering problems, a person tends to swing his eyes and head consistently in one direction (Kinsbourne, 1972). Observation of the direction of eye movement has been used by a number researchers to indicate cerebral specializations (Albert, 1975; Duke, 1968; Kimura, 1969; White, 1972).

Day (1967) declared that the direction of eye movement has physiological, cognitive style, and personality correlates. Day was among the first to hypothesize that eye movement reflects cerebral asymmetry: right movers being more dependent on the analytical left hemisphere and left movers being more dependent on the spatial, non-linear processing mode of the right hemisphere.

It has been found that right movers, dependent on the left hemisphere, make earlier career choices (Bakan, 1971), tend to major in science and quantitative areas, and perform better than left movers on propositional and math skills of the Scholastic Aptitude Test (Weiten & Etaugh, 1973). In

the same study conducted by Weiten and Etaugh, right movers were found less aesthetic and had fewer social interests than did the group of left movers. The right movers consistently outperformed the left movers on concept-identification tasks emphasizing verbal and analytical skills.

Left movers, those dependent on the right hemisphere's processing system, were found to be more aesthetic, participated in more social activities, had more vivid imagery, and tended to major in the classical and humanity area. They outperformed the other group on perceptual motor skills and tended to focus more on internal experiences than did the right movers.

A pattern emerges, consistent with what is already known about the two hemispheres. Left movers were found superior on imagery and perceptual motor skills; right movers were found superior in verbal and analytical skills. The research will study the cerebral language arrangement of bilinguals as measured by visual shift.

CHAPTER III

METHODOLOGY

Design of the Study

The design of this experimental study is Quasi-Experimental. A Time Series Plan will include four variations of treatment and one observation for each treatment.

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Location of the Study

The study was conducted at the Racine Migrant Program being held during the summer of 1980 at Horlick High School, Racine, Wisconsin. The criteria of eligibility for the Migrant Program is socio-economic. For a student to be eligible, at least one of his parents must have been a migrant worker during the past five years.

The Migrant Program emphasizes study skills and life survival skills. It is held during the morning only, and efforts are made for the students who are of age to obtain afternoon jobs through the program.

Criteria for eligibility is not dependent on grades, I.Q., or achievement scores. It is a voluntary program.

Sample Selection

The subjects selected for this study were 32 children from the study location as listed. To be eligible a child was required to speak both English and Spanish and be right-handed. The ages represented were 12-16 years. There were 14 males and 18 females in the sample.

The children were selected from three classrooms. Each child was tested individually.

Instrumentation

Most of the methods for assessing cerebral involvement require the use of machines. The visual-shift method of data collection has been chosen as most convenient for the purposes of this study.

The visual shift method of assessing cerebral participation was used in the study. Bakan and Strayer (1973) did a test-retest reliability on the direction of eye movement. The subjects were given a series of Proverbs to ponder and interpret in their own words on two separate occassions. The product-moment correlation for the number of consistent eye movements was .78 for the total sample, .72 for males, and .80 for females.

Day (1967) found that the direction of movement is not related to eye dominance or age. It has also

been noted that reflective questions produce eye movement at the rate of 94% while factual questions produce only 36% eye movement (Duke, 1968). The questions asked in this study were reflective in nature for this reason.

Consistency of direction of eye movement has also been noted in a number of research studies. Bakan and Svorak (1969) found that 72% of the eye movements of subjects were in the same direction. Weiten & Etaugh found 79.9% consistency and Day (1967) found 75% consistency.

Visual shift appears to represent a switch from external to internal processing. Visual shift, that is, looking away from the examiner upon being asked a question, has been found to be a function of eye movement contralateral to cerebral activity.

Method of Data Collection

Arrangements were made so that there was a quiet place in the hall where the study could take place. A chair was placed directly in front of the examiner's desk. Questions were of a verbal-reflective nature so as to induce a maximum amount of visual shift. The questions used are listed in Appendix B.

Efforts were made to have all subjects looking directly at the examiner during each question. A response was scored Invalid if the subject was not

looking at the examiner at the end of each question. The response was scored Invalid if there was any doubt regarding direction of eye movement. If the subject did not change his gaze when asked a question, the response was scored in the None (N) Category.

The direction of visual shift was noted and tabulated. The first two questions were asked in English, the second two questions in Spanish. If the subject did not respond in the language of the inquiry, the response was marked Invalid.

Data Analysis

A chi square test was applied to check consistency of visual shift as well as frequency of visual shift in each language.

Implementation

The main problem involved in this study was the securing of permission and cooperation of authorities. It was necessary to obtain permission from Dr. Orville Totdahl, Director of Research and Development of the Racine Unified School District; Mr. Ezequiel Vargas, Director of the Racine Bilingual Program; Ms. Leslie Roanhouse, CESA 18 Director; Ms. Florencia Garza, Director of the Racine Summer Migrant Program; and Mr. Victor Moreno and Ms. Cheryl Mochalski, teachers in the Migrant Program.

CHAPTER IV

RESULTS

Introduction

The purpose of this chapter is to present and discuss the results of this research as related to the null hypothesis:

> There is no significant difference in cerebral arrangement as measured by visual shift for a group of Mexican Americans when answering questions in English and when answering questions in Spanish.

A chi square analysis was used to test the null hypothesis to determine whether or not significant differences in responses existed among the study group on each of the variables and the direction of visual shift. In the chi square analysis, the null hypothesis of no significant difference was rejected when observed differences among the responses would have been expected to occur by chance fewer than one time in ten thousand similar samples.

Demographic Profile of the School District

Racine's Unified School District provides K-12 education for approximately 32,000 young people. The district has six junior high schools and three senior

high schools. Bilingual-Bicultural Programs are available at four of the junior highs and all of the senior high schools.

One of the programs the district offers is the Summer Migrant Program. The Migrant Program is open to all Spanish-speaking children whose parents have been employed as migrant workers during the past five years.

Sample Population

The student population in this study consisted of 32 secondary students enrolled in the Summer Migrant Program in Racine, Wisconsin. All students sampled spoke and understood both Spanish and English. Their first language was Spanish. Their ages ranged from 12 to 16. There were 14 males and 18 females in the sample. Table 1 reports the tally of selected demographic variables for the sample population.

Table 1

Total Sample Population by Number and Percent

Variable	Number	Percentage
Sex		
Male	14	44%
Female	18	56%
Age		
12	1	3%
13	6	19%
14	15	47%
15	9	28%
16	1	3%
Birthplace		
Mexico	12	37%
United States	20	63%
Age of Second Language Acquisition		
0- 4	10	31%
5- 8	16	50%
9-12	6	19%
	n=32	

Table 2 presents the six variables used in this study. Variables 1 through 4 represent secondary source data. Variables 5 and 6, visual shift and language of inquiry, are the primary data as related to the null hypothesis.

Table 2

Demographic Variables in Survey Instrument

Variable No.	Variable
1	Sex (Male - Female)
2	Age (12 - 16)
3	Birthplace (Mexico - United States)
4	Age Second Language Acquisition (0 - 4; 5 - 8; 6 - 12)
5	Language Inquiry (Spanish - English)
6	Visual Shift (Left - Right)

Results of Primary Data

Table 3 reports the results of the chi square test of significance on the two by two table containing the variables of visual shift as related to language of inquiry.

Table 3

Results of Chi Square on Visual Shift and Language of Inquiry

	Shift Left	Shift Right	Raw Total
English	13 20.3%	51 79.7%	64 100%
Spanish	52 81.3%	12 18.8%	64 100%
Column Total	65 50.8%	63 49.2%	128 100%

* x^2 of 45.1 with 1 degree of freedom is significant at .001.

Table 3 reports that 79.7% of the students sampled shifted to the right when the questions were asked in English. 81.3% of the sampled students shifted to the left when the language of inquiry was Spanish. The calculated chi square reported in Table 3 was 45.1 with one degree of freedom which is

significant at the .001 level. Therefore, the null hypothesis of no significant difference among rows and columns was rejected and the alternative hypothesis of a significant difference among rows and coulumns was accepted.

The observed chi square value was smaller than the chi square ratio needed for significance at the .001 significance level. Thus, it can be concluded that there was no significant difference among the respondents. The respondents in this study shifted to the right when questions were asked in English and to the left when questions were asked in Spanish. Thus, we may deduce that the English language appears to be left hemispheric, and the Spanish language right hemispheric for the population of this study.

Although the left hemisphere is the verbal hemisphere for 90-95% of the general population (Kinsbourne, 1978), there are indications from the results of this study that there is a change in cerebral arrangement as a result of the acquisition of a second language. Among the sampled population Spanish was the first learned language. It can be assumed that it was at one time left hemispheric. However, the results of this study indicate that, for the majority of the participants, Spanish is now right

hemispheric. One may deduce from the findings that the acquisition of second languages appears to cause a change in cerebral arrangement.

The possibility of the right hemisphere being involved in language is not without a research base. In Chapter II, Related Research, the investigator examined research related to: a) aphasiological evidence, b) postmortem studies of bilinguals and polylinguals, c) recovery patterns among aphasic bilinguals and polyglots, and d) direct studies of cerebral arrangement and language. Each area substantiated the possibility of bilateral language arrangement for individuals who speak two or more languages.

Results of Supplementary Data

While the results presented in Table 3 represent the major finding of this study as directly related to the posed null hypothesis, the tables on the following pages indicate the results of the statistical analysis on 2 x 2 tables dealing with the secondary variables.

A chi square test was applied to the crossed tabulations in the 2 x 2 tables for the secondary variables used in this study. Tables 4 and 5 compare the results for males and females as related to visual shift patterns. Tables 6 and 7 compare the visual

patterns for those born in the United States and those born in Mexico. Tables 8, 9, and 10 present the results of the visual shift patterns as identified by age of second language acquisition.

Table 4

Results of Chi Square on Males and Visual Shift

	Shift Left	Shift Right	Raw Total
English	7 25.0%	21 75.0%	28 50%
Spanish	24 85.7%	4 14.3%	28 50%
Column Total	31 55.4%	25 44.6%	56 100%

* x^2 of 21.3 with 1 degree of freedom is significant at .001.

Table 5

Results of Chi Square on Females and Visual Shift

	Shift Left	Shift Right	Raw Total
English	6 16.7%	30 83.3%	36 50%
Spanish	28 77.8%	8 22.2%	36 50%
Column Total	34 47.2%	38 52.8%	72 100%

* x^2 of 27.1 with 1 degree of freedom is significant at .001.

Results reported in Table 4 and 5 indicate that males and females show similar patterns of visual shift. 75.0% of the males and 83.3% of the females shifted to the right upon being asked a question in English. When Spanish was the language of inquiry, 85.7% of the males shifted to the left and 77.8% of

the females shifted to the left. Both males and females indicate a similar pattern according to percentages and chi square values.

The calculated chi square value reported in Table 4 was 21.3 with one degree of freedom which is significant at the .001 level. Table 5 reports a calculated chi square of 27.1 with one degree of freedom which is significant at the .001 level. Therefore, the null hypothesis of no significant difference among rows and columns was rejected and the alternate hypothesis of a significant difference among rows and columns was accepted.

Tables 6 and 7 report the results of the chi square test as applied to the crossed tabulations of visual shift and place of birth. These tables compare those students in the sample population who were born in Mexico and those students who were born in the United States. The researcher was interested in finding out if birthplace was a factor in visual shift patterns.

Table 6

Results of Chi Square on U.S. Born and Visual Shift

	Shift Left	Shift Right	Raw Total
English	10	28	38
	26.3%	73.7%	50%
Spanish	28	10	38
	73.7%	26.3%	50%
Column Total	38	38	76
	50.0%	50.0%	100%

* x^2 of 15.2 with 1 degree of freedom is significant at .001.

Table 7

Results of Chi Square on Mexical-Born and Visual Shift

	Shift Left	Shift Right	Raw Total
English	3	23	26
	11.5%	88.5%	50%
Spanish	24	2	26
	92.3%	7.7%	50%
Column Total	27	25	52
	51.9%	48.1%	100%

* x^2 of 30.8 with 1 degree of freedom is significant at .001.

Table 6 and 7 report that no significant differences were found concerning visual shift and place of birth. Those who were born in Mexico did, however, indicate a stronger pattern of visual shift than those students who were born in the United States. 88.5% of the students born in Mexico as compared to 73.4% of those born in the United States shifted to the right when asked questions in English. 92.3% of the students born in Mexico as compared to 73.7% of those born in the United States shifted to the left when the questions were asked in Spanish. Thus, although both groups showed similar patterns of visual shift, the group born in Mexico showed the pattern to a greater degree than did the United States-born group.

The calculated chi square reported in Table 6 was 15.2 with one degree of freedom, which is significant at the .001 level. Table 7 reports a calculated chi square of 30.8 with one degree of freedom which is significant at the .001 level. Therefore, the null hypothesis of no significant difference among rows and columns was rejected and the alternate hypothesis of a significant difference among rows and columns was accepted.

Evidently, the Mexican-born students indicate a more pronounced tendency of English as being left hemispheric and Spanish as being right hemispheric. Although both groups show this pattern, the difference between the groups is not without significance. For the group born in Mexico, Spanish was not only the first language; it was the only language. We may presume that the Spanish language was at one time a part of the verbal left hemisphere. However, the tendency for this group to show a shift in brain arrangement is greater than for the U.S.-born group. For those born in Mexico, there are strong indications of a right cerebral dominance in Spanish and a left cerebral dominance in English.

Tables 8, 9, and 10 record the results of the chi square test as applied to visual shift and the age of second language acquisition. Table 8 reports the result of the chi square test on the 2 x 2 table of visual shift patterns and students in the sampled population who had acquired English at or before the age of 4. Table 9 reports the chi square results of visual shift patterns for the students who acquired English between the ages of 5 and 8. Table 10 reports the results of the chi square test for students who learned English between the ages of 9 and 12.

All of the students in this study acquired the Spanish language before they learned English. Spanish was the language of their family and the first language to which they were exposed. They do differ, however, as far as the exact age that they began to learn English. For simplicity purposes, they were assigned to three groups in this study: a) those who acquired English before the age of 4, b) those who learned English between the ages of 5 and 8, and c) those who learned English between the ages of 9 and 12.

Table 8

Results of the Chi Square on Visual Shift and the Age of Second Language Acquisition (0-4)

	Shift Left	Shift Right	Raw Total
English	4	16	20
	20.0%	80.0%	50%
Spanish	16	4	20
	80.0%	20.0%	50%
Column Total	20	20	40
	50.0%	50.0%	100%

* x^2 of 12.1 with 1 degree of freedom is significant at .001.

Table 9

Results of Chi Square on Visual Shift and Age of Second Language Acquisition (5-8)

	Shift Left	Shift Right	Raw Total
English	9	23	32
	28.1%	71.9%	50%
Spanish	24	8	32
	75.0%	25.0%	50%
Column	33	31	64
Total	51.6%	48.4%	100%

* x^2 of 12.3 with 1 degree of freedom is significant at .001.

Table 10

Results of Chi Square on Visual Shift and Age of Second Language Acquisition (9-12)

	Shift Left	Shift Right	Raw Total
English	0	12	12
	0.0%	100.0%	50%
Spanish	12	0	12
	100.0%	0.0%	50%
Column	12	12	24
Total	50.0%	50.0%	100%

* x^2 of 20.1 with 1 degree of freedom is significant at .001.

The tabulations from Tables 8, 9, and 10 indicate no significant differences in regard to the age of second language acquisition and patterns of visual shift. All three groups showed similar visual shift patterns. The calculated chi square reported in Table 8 was 12.1 with one degree of freedom which is significant at the .001 level. The chi square reported in Table 9 was 12.3 with one degree of freedom which is significant at the .001 level. Table 10 shows a calculated chi square of 20.1 with one degree of freedom which is significant at the .001 level. Therefore, the null hypothesis of no significant difference among rows and columns was rejected and the alternate hypothesis of a significant difference among rows and columns was accepted.

As reported in Tables 8, 9, and 10 all three groups showed similar levels of significance. In other words, all three groups indicate English to be left hemispheric and Spanish to be right hemispheric. On the basis of visual shift, the right hemisphere was used to process the questions in Spanish; the left hemisphere was used to process the questions in English. Table 10 records the results of visual shift for the group which learned English last, that is, between the ages of 9 and 12. For this group there is

a 100% difference in visual shift patterns as related to the language of the question. 100% of the students in this group shifted to the right when asked questions in English and to the left when asked questions in Spanish. For this group of students, the tendency of a cerebral shift in languages appears to be 100%.

Although research indicates that the plasticity of the brain grows less as a child matures, the results indicated in this study of bilinguals indicates that there appears to be a cerebral shift due to second language acquisition at least through the age of 12. Those who acquire English last show thegreatest possibility of a shift of Spanish to the right hemisphere with English taking its place in the left hemisphere.

Summary of the Findings

This chapter sets forth the results in chi square and percentages of the independent variables as related to visual shift patterns. The values were used as one standard of measure for the chi square results. The chi square results show the frequency distributions of the sample responses, and whether one or more of the variables in the study was significant at or greater than the .001 level of significance.

The percentages, in turn, reveal the percent of responses showing a visual shift to the right or left when questions were asked English as compared to visual shift when questions were asked in Spanish.

The interpretations of the data and conclusions of this research were principally based upon the chi square test of significance. The primary source data, that is, visual shift as related to the language of inquiry, was significant at the .001 level. The results of the chi square test show that all the secondary variables in the study have approximately the same level of significance as related to visual shift and language of inquiry.

CHAPTER V

INTERPRETATIONS, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This chapter sets forth the investigator's interpretations of the results and findings of the research concerning cerebral patterns among the bilingual students sampled in this study. The null hypothesis posed for the study was:

> There is no significant difference in cerebral arrangement as measured by visual shift for a group of Mexican-Americans when answering questions in English and when answering questions in Spanish.

The discussion, conclusions, and summary are presented along with recommendations for future study.

Development of the Study

Initially, the purpose of the research for this study was to explore the possibility that bilingual students might have a different cerebral arrangement for each language they speak. The widely-held idea that the Mexican-American culture is the cause of the academic failure of the Mexican-American students is no longer accepted among educators. The position taken by the investigator is that the cause of failure of the Mexican-American is not to be found in the

culture. Speculations concerning academic failure of Mexican-Americans, learning style, and the possibility of a biological basis for this learning style led to the present research study.

Rationale for Acceptance or Rejection of Hypothesis

The null hypothesis was measured on the basis of the chi square test of significance. The result of the chi square test on the frequency distribution of visual shift and the language of inquiry revealed a 45.1 chi square with one degree of freedom, significant at the .001 level. The null hypothesis was rejected on this basis.

Alternative Hypothesis

The rejection of the null hypothesis implies the acceptance of the alternative hypothesis which may be stated in the following manner:

> There is a significant difference in cerebral arrangement as measured by visual shift for a group of Mexican-Americans when answering questions in English and when answering questions in Spanish.

Discussion

The findings of the research study were derived from the tabulations of visual shift as observed by the examiner. Tabulations were made for each

question. Two questions were asked in Spanish and two questions were asked in English. A comparison study was made as to the differences in visual shift when students answered questions in English and when they answered questions in Spanish. The primary and secondary source data were analyzed according to the chi square test of significance in order to arrive at a frequency distribution in regard to visual shift patterns.

The findings of the study led the researcher to reject the null hypothesis. A chi square value of 45.1 with one degree of freedom was found to be significant at the .001 level. In other words, a significant difference in the direction of visual shift as related to language was found. The difference was related to the language used in the questions.

Students sampled in this study tended to shift to the right when answering questions in English. The students showed tendencies to shift to the left when reflecting upon questions asked in Spanish. As explained previously, a right visual shift is indicative of left hemispheric involvement; a left visual shift is indicative of right hemispheric involvement. Thus, it was found that, for the 32

students sampled in this population, the left hemisphere appeared to be the preferred mode of thought in English, whereas the right hemisphere seemed to be the preferred mode for processing questions in Spanish.

Orbach's study (Harcum, 1978) is one of the few studies of bilinguals which attempts to measure cerebral patterns in both native language and second language. Orbach found that, when Hebrew was the native language, English was better recognized to the right, Hebrew to the left. The present study had similar results. The native language appeared to indicate a right dominance, the second language, a left dominance.

The supplementary data deals with the assigned variables of sex, age, birthplace, and age of second language acquisition. Each of these variables was found to be significant at approximately the .001 level of significance.

Age was not found to be a differential factor in visual shift. This is consistent with the body of research that indicates that brain lateralization takes place before the age of 5 (Entus, 1977; Kinsbourne, 1978; Molfese, 1977; Witelson, 1977).

Neither was sex found to be a factor in visual shift patterns. This is consistent with results found by Weiten and Etaugh (1973), Etaugh (1972), and Witelson (1976). Both males and females in this study showed similar levels of significance at the .001 level.

Neither birthplace nor age of second language acquisition were found to be factors in visual shift patterns. The researcher was not able to find studies dealing with these variables as related to bilingual students and cerebral patterns. As reported in Chapter IV, the present research indicated that the sample population born in Mexico showed a visual shift to the right for English and to the left for Spanish to a greater degree than did those students in the sample who were born in the United States. The group that acquired English as a second language between the ages of 9 and 12 showed a 100% significant difference in visual shift as related to language acquisition.

Conclusion

Most people prefer one mode of consciousness, that is, one hemisphere's mode of processing, over the other (Ornstein, 1976). Most people also have a preferred learning style. What is new in recent research, and what is confirmed in this study, is that

there are indications that these models are biological as well as cultural and individual.

The study undertaken here was exploratory in nature. The researcher's purpose was to investigate the possibility of differences in cerebral patterns as measured by visual shift, and its relation to the native and second language. The results as shown in Chapter IV indicate that there is a possible relation between cerebral arrangement and each language. The population sampled in this study appear to have a right dominance in the Spanish language and a left domonance in the English language. The results are especially striking when we consider that the students in the population sampled learned Spanish as their first language. A shift appears to have taken place when English was acquired as a second language.

Conclusions about the general Mexican-American population are speculatory in nature. Generalizations are limited by the lack of random sampling and the relatively small population utilized in this study. However, the consideration of the possibility of cerebral patterns as related to the native and second language is not without significance. Among this population, the finding that the Spanish language shows tendencies to be right lateralized, the English

language left lateralized, accompanies the body of knowledge which indicates that:

1. Mexican-Americans are predominantly Field Sensitive in cognitive style (Castañeda & Ramirez, 1974; Messick & Damarin, 1964; Moore & Cuellar, 1970; Witkin, 1974).

2. The Field Sensitive learning style has been found to show striking similarities to the right hemisphere's mode of processing (Bogen, 1969; Bryden & Allard, 1978; Kinsbourne, 1978; Krippner, Dreistadt, & Hubbard, 1972; Ornstein, 1973, 1976).

3. The American school system has been found to be predominantly Field Independent in its instruction (Castañeda & Ramirez, 1974, 1977; Cohen, 1969, 1971).

4. Teachers of Mexican-American bilingual students should consider that these students are predominantly Field Sensitive in learning style. This consideration would have implications for the methods of instruction, classroom environment, assessment, and methods of reward.

5. It appears, from the results of this study, that there is a change in cerebral arrangement due to second-language acquisition.

6. There exists the possibility that a factor in the Mexican-American's continued academic failure is

the lack of congruency between the school's teaching approach and the child's learning style as based on brain functions.

Future Recommendations

Recommendations for further research include the following general areas:

1. What are the unique learning experiences of children in a different culture that promote the development of a unique learning style?

2. Once learning style is addressed for children receiving their education in their second language, which are the most appropriate methods of instruction?

3. What are the main areas of difficulty for children receiving their education in two languages? It is possible, in examining the results of this study, that the native language may lend itself more readily to some disciplines; the second language to other academic areas.

Mathematics, for example, is basically an analytical discipline which would be consistent with the processing mode of the linear, analytical, sequential left hemisphere. Mathematics, then, might be best taught in the English language, which was found to be left hemispheric in this study. Disciplines such as music, art, and even the global

concepts of each discipline are more consistent with the processing mode of the holistic, creative, right hemisphere. These academic areas might be better instucted in the Spanish language, which was found in this study to be right hemispheric.

4. The researcher urges studies that will more accurately assess degrees of cerebral involvement in the thought process of native and second languages. Appropriate methods such as the dichotic listening tests, tachistoscopal presentations, cortical blood flow, and measurements of average evoked response and alpha waves would provide a scientific base.

Summary

The purpose of the experiment conducted in this study was exploratory in nature. The researcher was interested in examining the possibility of cerebral patterns as related to language among bilingual Mexican-American students.

Specifically, the null hypothesis tested in this study was:

> There is no significant difference in cerebral arrangement as measured by visual shift for a group of Mexican-Americans when answering questions in English and when answering questions in Spanish.

The sample in this study consisted of 32 Mexican-American students in Racine, Wisconsin who were bilingual in Spanish and English. Ages ranged from 12 through 16. There were 14 males and 18 females in the sample population. In all cases, Spanish was their native language.

The visual shift method was used to measure cerebral involvement in thought processing. Research has found that people tend to shift their eyes to the left or to the right upon being asked a question of a reflective nature. A visual shift to the right indicates left hemispheric involvement in thought processing. A shift to the left indicates the right hemisphere's involvement in thought. In general, the left hemisphere has an analytical, linear, and sequential processing mode (Agranowitz & Mc Keown, 1975; Ornstein, 1973). The right hemisphere is spatial, relational, and holistic in processing (Bogen, 1976; Harnad, 1972; Sperry, 1964).

The researcher wanted to examine the possibility of a different cerebral arrangement for the native language than for the second language, the implication then being that there may be a different processing mode and consequently, a unique learning style for each language.

Four questions were asked of each person in the sample. The first two questions were in English and the last two questions were in Spanish. The students were requested to answer each question in the language of inquiry. Tabulations were made of visual shift while reflecting upon each question. The chi square test of significance was used to report the frequency distribution of sample responses. Visual shift as related to the language of inquiry was found to be significant at the .001 level. A total of 79.7% of the student population in the sample shifted to the right when pondering questions which were asked in English. A total of 81.3% of the sampled students shifted to the left when the language of inquiry was Spanish. Thus, for the population of bilingual Mexican-Americans in this study, the left hemisphere appeared to be preferred mode of thought for the processing of questions in the English language. However, the right hemisphere seemed to be the preferred mode for the processing of questions asked in the Spanish language. From the findings as reported in this study, there appears to be a cerebral shift upon the acquisition of a second language.

APPENDIX A

July 8, 1980

Dr. O. Totdahl
Research and Development
Washington Center
914 St. Patrick Street
Racine, WI 53407

Dear Dr. Totdahl:

I am presently attending U.W.-Whitewater where I am finishing a Master's Degree. I am currently writing a thesis dealing with cerebral dominance among bilingual students and the relation this has with cognitive learning styles. Part of the thesis requires a small study where I will be asking a numerical type question in each language and checking visual shift patterns. Estimated time with each student would be one or two minutes and I would propose a sample of some 30 junior high bilingual students in the Migrant Program at Horlick High School. I would very much appreciate your allowing me to carry out this study.
Should your answer be affirmative, I would like to carry out the study on Friday morning, July 18. For expediency sake, perhaps you could call Ezequiel Vargas and relay your decision to him. I will be in contact with him throughout next week.
Thank you very much for your consideration.

Sincerely,

Kathryn Brue de Lorenzo

cc: Ezequiel Vargas - Bilingual Director
Leslie Roanhouse - CESA 18 Director
Florencia Garza - Migrant Program Director
Victor Moreno - Secondary Instructor
Cheryl Mochalski - Secondary Instructor

APPENDIX B

Two questions were chosen in each language from among the following questions:

English Language

1. Tell me a word that begins with the letter s and ends with the letter s.
2. What is one thing you've learned at school this summer?
3. What is better about summer school than the school you attended during the regular school year?
4. What is the main problem at school?

Spanish Language

1. ¿Dónde naciste? (Where were you born?)
2. ¿Cuál es la cosa mas importante que te enseñan tus padres? (What is the most important thing your parents teach you?)
3. ¿Cuál es tu maestro favorito este verano? (Who is your favorite teacher this summer?)
4. Si fueras el director de esta escuela, ¿qué cambios harias? (If you were director of this school, what changes would you make?)

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